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Assessment of Pulmonary Function Parameters and Respiratory Symptoms in Shipyard Workers of Asaluyeh City, Iran

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Background: Workers in shipyard companies are exposed to different respiratory hazards. The present case-control study was designed to evaluate pulmonary function tests and respiratory symptoms among shipyard workers in Asaluyeh city in Southwest Iran.

Material and Method: Between March and October 2015 we recruited participants from two separate populations: shipyard workers as cases and office workers from the same shipyard company, who are not exposed to the same respiratory hazards, as controls. History was obtained from all participants and they all underwent physical examination and spirometry.

Results: Respiratory signs and symptoms were present in a significantly higher number of shipyard workers compared to the unexposed office workers. Similarly, there were significant spirometric differences between cases and controls.

Conclusion: It seems that workplace hazards play a more significant role than other factors such as air pollution in development of respiratory diseases, and future studies for investigating respiratory symptoms, pulmonary function parameters, biological monitoring and measurement of respiratory hazard need to be performed.

Key words: Respiratory symptoms; Shipyard workers; Spirometry

INTRODUCTION

Epidemiological studies have shown that industrial workers are exposed to respiratory hazards and may suffer short and long term consequences, as noted on their pulmonary function tests. Aghilinejad et al. previously reported that among stone industry workers who had been exposed to silica, prevalence of respiratory symptoms such as cough and dyspnea had increased even in those with normal spirometry pattern (1). Shipyard workers are exposed to different respiratory hazards as a consequence of their jobs (2). According to previous studies, arc welding, metal and tungsten-inert gases, and submerged arc are commonly used in the shipyards and mainly involved steel, aluminum, copper and nickel (3). Furthermore, shipyard workers may be exposed to other health hazards such as asbestos, lead, cadmium, arsenic, benzene, and formaldehyde, which can cause respiratory symptoms and in some cases cause changes in spirometry pattern. Asaluyeh is an industrial city in Southwest Iran and most of the studies related to petroleum and shipyard industries took place in this city. Environmental reports have repeatedly shown that air pollution indices are higher than normal in Asaluyeh. It seems that more than this air

pollution, workers of some industries such as shipyard had some of harmful exposure in their workplace and had impact on their pulmonary function tests. Based to this hypothesis the current case-control survey was designed to assess pulmonary function tests and respiratory symptoms of shipyard workers in Asaluyeh.

MATERIALS AND METHODS

Study subjects

The study protocol was approved by the ethics committee of the Iran University of Medical Sciences. Between March and October 2015 we recruited participants from two separate populations. The first group included more than 500 shipyard workers who were exposed to hazardous material, as the exposed group. Investigators reviewed each individual's job description to determine those who were directly exposed to respiratory hazards at workplace. The occupational physician and safety officer verified the at-risk population. The present study included 242 male workers of a shipyard in Asaluyeh in Southwest of Iran who were exposed to respiratory hazards at work as cases, and 250 unexposed office workers as controls. We defined exposed workers as those who were employed for over a year and worked on regular basis at the shipyard. The second group were recruited from unexposed office workers (management team) of the same shipyard, who were not exposed to respiratory hazards and spent most of their time at work outside the shipyard.

Respiratory history and physical examination

Participants completed a questionnaire that inquired about respiratory symptoms such as dyspnea, cough, and sputum production. Subsequently the study pulmonologist examined all participants and auscultated their lung to assess for presence of respiratory sings such as whizzing, crackles, and rhonchi.

Spirometry

Two trained technicians performed spirometric measurements according NIOSH spirometry guidelines, using two SPM 300 spirometers (SPM 300 Bionet Inc., South Korea). The quality grading function was activated. An independent pulmonologist reviewed the results to assure that they met the international criteria for acceptability and repeatability. Abnormal spirometry values included FEV1 and FVC, values, or FEV1/FVC ratios that fell below the lower limit of normal (LLN).

Statistical analysis

Study data were entered into the SPSS version 16.0 (SPSS Inc. Chicago, Ill) and analyzed. Continuous data are shown as mean ± standard deviation and discrete variables are presented as frequencies (percentages). We used Chi-squared statistical test and independent sample t-test to compare demographic variables between exposed and un-exposed groups. We set 95% as level of confidence and all of $P < 0.05$ was considered statistically significant.

RESULTS

The present study included 242 male workers of a shipyard in Asaluyeh in Southwest of Iran who were exposed to respiratory hazards at work as cases, and 250 unexposed office workers as controls. The mean age of the exposed participants was 34.02 ± 9.05, while the mean age of the unexposed group was 35.08 ± 7.06, $P = 0.15$. The mean work experience (in years) for the unexposed group was significantly higher than that of the exposed group (11.83 ± 1.48 vs. 8.62 ± 2.43; $P < 0.001$). Sixty-seven cases (27.7%) and 62 controls (24.8%) were smokers. There was no significant difference between smoking rate among the cases and the controls ($P = 0.47$). At the beginning of the study two participants in the exposed group suffered from asthma and three had chronic bronchitis, while only one participant in the unexposed group has asthma and another had chronic bronchitis. Overall respiratory signs and symptoms and (cough, dyspnea, sputum production, wheezing and crackles) were reported to be significantly higher in the exposed group in comparison with the unexposed group [80 (33.06%) vs. 39 (15.6%); $P < 0.001$)] (Table 1).

Table 1. Comparison of respiratory signs and symptoms among study groups

Symptoms/signs	Exposed group	Unexposed group	P-value
Cough	42	26	0.03
Sputum	12	4	0.04
Dyspnea	28	16	0.04
Cough + sputum	9	2	0.03
Cough+ dyspnea	19	11	0.11
Sputum + dyspnea	16	3	<0.001
Sputum + dyspnea + cough	7	2	0.12
Whizzing	18	7	0.02
Crackle	3	2	0.68
Rhonchi	2	1	0.62

Comparing spirometric patterns between the exposed and unexposed workers

Two hundred and three cases (83.89%) had normal spirometry results, 31 (12.81%) had obstructive disease pattern, four (1.65%) had restrictive disease pattern, and four (1.65%) had mixed disease pattern. In the unexposed group, 241 (96.4%) had normal spirometry pattern, six (2.4%) had obstructive pattern, two (0.8%) had restrictive patterns, and one (0.4%) had a mixed pattern. There was a significant difference between spirometry patterns between the cases and the control ($P < 0.001$). Comparing demographic information and work-related parameters among participants with abnormal spirometry patterns in both groups showed no significant difference in mean age between the two groups (41.18 ± 9.17 vs. 39.73 ± 9.24; $P < 0.08$). Similarly, there was no significant difference in mean work experience (in years) between the cases and the controls with abnormal spirometry findings (9.15 ± 1.56 vs. 9.69 ± 1.48; $P = 0.32$). There was no significant difference in mean smoking rate (pack/years) between the cases and controls, who showed abnormal spirometry patterns (2.21 ± 0.18 vs. 2.17 ± 0.21; $P = 0.25$).

DISCUSSION

Among study participants, abnormal spirometric indices were observed in 39 cases and 9 controls ($P < 0.05$). Our findings showed no significant differences in mean age, smoking rate, or mean work experience between the two groups. Overall respiratory symptoms and signs were reported more frequently in the exposed group ($P < 0.05$). There was no significant difference in mean smoking rate (pack per year) in participants with abnormal spirometry findings between the two groups. Asaluyeh is a city in Bushehr province in Southwest Iran, which has expanded rapidly since 1998 due to the development of petroleum and gas refineries and more than 45 petroleum torches and 15 refineries were created over this time period. According to the measurement of air pollution parameters in Asaluyeh at the time of this study, the levels of naphthalene, acenaphthalene, PM10, O_3, NO_2, SO_2, and H_2S were much higher than their allowed levels. Air pollution is responsible for 1.4% of work related mortalities (4) and in most studies nitrogen oxides, carbon, ozone and sulfur have been reported as the main pollutant (5). Some studies have shown that people who live in areas with air pollution or high incidence of suspended particles in the air have declined pulmonary function (6). In Asaluyeh, the odor of gas and other chemicals such as urea, ammonia, and petroleum products is widely distributed in the air and citizens of this city have a high risk of developing pulmonary and cardiac disorders.

Our findings show that shipyard workers who are to hazardous respiratory particles had a significantly higher rate of respiratory signs and symptoms as well as abnormal spirometry patterns compared to office workers who worked for the same company but not exposed to respiratory hazards. We attempted to control for the impact of air pollution on development of respiratory signs and symptoms and declines in pulmonary function tests. Members of both groups lived in the same city and were exposed to similar air pollutants. Similar studies have reported smoking as a major cause of decline in respiratory functions among industrial workers. Linares et al reported that long term exposure to air pollution increases mortality from lung cancer and increases the risk of developing respiratory disorders (7). In our study smoking rate (packs per year) and the number of smokers were not significantly different between the two groups. On the other hand,

despite controlling for most of the risk factors for respiratory signs and symptoms, the higher rates of noted complications among shipyard workers might be due to higher rates exposure to respiratory hazards at work. The guidelines of international organization such as the occupational safety and health administration (OSHA) report that shipyard workers are exposed to workplace respiratory hazards such as asbestos, lead, cadmium, arsenic, benzene and formaldehyde.

Our results emphasize the impact of workplace respiratory hazards on declining respiratory functions and development of respiratory signs and symptoms. Future studies are required for evaluating biological monitoring and measurement of respiratory hazard, rate of respiratory symptoms and pulmonary function test.

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